

Mr. Auld, in the *Adelaide Advertiser*, of December 20, 1862, confirms this experience, and writes:

The hottest weather experienced by the exploration party was within or near the boundaries of South Australia, and they never experienced a hot wind in the interior.

Following the unprecedentedly dry winter of 1902, these storms became more pronounced during the spring months, and continued with varying intensity according as the wind circulation of passing atmospheric depressions favored their formation and distribution. They undoubtedly attained their culmination in the great storm of November 11 to 13, 1902. This storm assumed a phenomenal character, especially in South Australia, Queensland, New South Wales, and Victoria. In the latter State the effect was extraordinary on the 12th, the majority of stations reporting gales of dust accompanied by lightning, balls of fire, and darkness in the daytime so intense that fowls went to roost in the afternoon, while people had to find their way about by the aid of lanterns. The ship *Airlie*, en route from Brisbane to Sydney, 13th to 15th of November, encountered a duststorm, the dust covering the ship from end to end. Several passing vessels experienced showers of the so-called red rain. Mr. H. Stuart Dove, of West Devonport, Tasmania, writes:

On November 12 I noticed that the sky to the north and northeast, from horizon halfway up to zenith, had assumed an extraordinary chocolate-brown tint, due to clouds of that color which were moving toward us from the northwest. Under these clouds and moving from the northeast were ashy-gray patches of strata, streaked with fantastic dark lines resembling bows and boomerangs. A few drops of rain which fell about 5 p. m. were charged with brown, earthy matter, and at 6 p. m. a paper which was held in the rain became spotted all over with blotches. At 6:20 p. m. the solid matter was still descending, but in less quantity. At 6:30 there was a marked diminution, and by 6:50 p. m. the rain was all but free from it.

In *Nature*, Vol. LXVIII, July, 1903, p. 223, P. Marshall, of Otago University, New Zealand, supplies an interesting account of a heavy dust fall and storms in various parts of that colony on November 14 and 15, which, he states, were not due to local causes, and he shows by microscopical and chemical examination of the dust and by the distribution of atmospheric pressure and resultant winds between Australia and New Zealand that the dust was probably transported from Australia over the 1200 miles of intervening ocean.

On November 15, 1902, Mr. Langdon, superintendent of the Eastern Extension Telegraph Company, Port Darwin, Australia, received the following cablegram from Banjoewangie:

Very hazy last few days; temperature high; wind variable from south to northwest. Sourabaya papers last week reported a heavy haze in the Java Sea, lying low on the water, supposed to be due to volcanic dust from Martinique. No eruption in Java, but on the 12th, between 4:30 and 5 p. m. (local time), a short, heavy shock of earthquake was felt at Zoenadjang, Malay, and Banjoewangie, direction east to west, attributed to the Sineru.

On November 17, 1902, the postmaster at Port Darwin sent the following message to Sir Charles Todd:

Color of haze or smoke, bluish gray. Slight shower of rain on 15th. Blaeser, of this department, took a clean sheet of glass and exposed it to the rain, allowing the rain water from the glass to run into a small, clean bottle. The rain water in bottle contains sediment of light, fluffy dust; color, gray. Haze very prevalent yesterday; also continues to-day, but not so dense as on Friday (i. e., 14th).

Captain Dabelle, of the steamer *Guthrie*, upon arrival at Port Darwin on November 16, 1902, reported that the steamer was delayed by difficulty in picking up the land, owing to the prevalence of the smoke which was encountered all the way between the Philippine Islands and Australia. The captain said that the smoke was unlike that from bush fires. On November 16 it was so thick that the bold headlands on North Australia at a distance of one mile were completely obscured. The haze could be plainly seen between clumps of trees, houses, and other objects less than 200 yards away.

Capt. C. Lindburgh, of the steamer *Tsinan*, upon arrival at

Port Darwin on November 24, 1902, supplied extracts from the ship's log during the last voyage northward from Port Darwin to Hongkong, and on his return passage from Hongkong to Port Darwin again. These show that a thick haze was experienced from October 17 to 21. During this time the officers never saw land and had trouble in getting observations. The captain reported the hazy weather on arrival at Hongkong, where it was supposed to be caused by volcanoes in Sumatra. It lasted from latitude 8° 16' south, longitude 129° east, to latitude 6° 34' north, longitude 123° 22' east. The barometer ranged from 30.14 to 30.00. On his return trip the haze commenced in latitude 1° 18' south, longitude 125° 27' east, and lasted until arrival in port. The phenomenon was generally considered to be due to volcanic disturbances.

The above notes show that the duststorm of November 11 to 13, 1902, involved the greater part of Australia and the surrounding ocean, at least as far as New Zealand. From this epoch they gradually lost their intensity and general character, at least so far as the whole of Australia is concerned, although they continued to be severe over interior parts of New South Wales up to the spring of 1903. They probably received a check by the widespread and useful rains which fell during the middle of February, 1903. These were largely due to an antarctic disturbance, and they spread over central Australia and the whole of Victoria, the falls registered ranging up to over two inches. This disturbance brought abnormally cold conditions for the time of the year. In Adelaide the 14th was, with one exception, the coldest day ever experienced in February, the maximum shade temperature being 64.8°. On February 19, 1883, it was one degree lower. A heavy fall of snow took place at Kiandra, N. S. W., on February 15, accompanied by a high wind from northwest, the temperature falling to 35°.

#### STORM OF AUGUST 20, 1904, IN MINNESOTA.

By T. S. OUTRAM, Local Forecaster, Minneapolis, Minn.

In Minneapolis, on the day in question, the sky was cloudy from about 8 a. m. until 5 p. m., when it cleared; but before 7 p. m. it clouded up again rapidly from the south with clouds which seemed at first to be somewhat high. These clouds had a rather greenish-yellow cast, and soon after 8 p. m. the whole sky was overcast and very stormy looking, a few persons saying that they saw many clouds of a pendulous shape, though no one has reported seeing anything that in any way resembled a tornado funnel. Light rain fell at intervals from 8:25 to 9:11 p. m., when it became excessive. During the period of excessive rainfall—from 9:11 to 9:56 p. m.—1.10 inches were recorded. It is not possible that the gage could have received the total amount of rainfall, as the sheets of rain, driven by the gale, must have fallen in a direction almost parallel with the top of the gage. Torrents of rain filled the streets with floods of water from curb to curb to a depth of 6 inches for probably ten minutes on grades which were steep enough to carry the water with a rapid current. At the station there were a few small hailstones for a minute or so, shortly before the heavy rain began, but in other parts of the city and in some parts of the country the fall of hail is said to have been heavy.

The self-register at the station shows the wind direction to have been north and northwest after noon; at 1:15 p. m. it became northeast; at 2:40 p. m., east; at 9:15 p. m., northeast; at 9:35 p. m., east; at 9:38 p. m., west; at 9:39 p. m., southeast; at 9:44 p. m., northeast; at 9:45 p. m., north; at 9:46 p. m., northwest; at 10:05 p. m., north; at 10:17 p. m., northeast; after which time the velocity was reduced to fresh. The velocities recorded by the anemometer were as follows: After about 3 p. m. the velocity was fresh; from 9:35 to 9:40 p. m. it was 45 miles per hour; from 9:40 to 9:45 p. m. it was 60 miles per hour; from 9:45 to 9:50 p. m. it was 84 miles per hour, with an extreme velocity of 110 miles per hour about

9:45 p. m. The barograph trace shows that after noon the pressure gradually fell from 28.82 inches to 28.67. Just about the time of the greatest severity of the storm the barograph pen dropped with great rapidity to 28.25, returning immediately and rising to 28.80, then dropping back quickly to 28.70, after which there was a slight fall until about 5 a. m. the next day. Two reliable gentlemen living near the residence of Hon. W. D. Washburn, which was near the center of the wide path of greatest damage, were watching an aneroid barometer at the time of the storm, and they state that the needle went down to 23 inches and returned almost immediately to near its former reading. This aneroid had been compared at this station not very long before the storm and found correct. Even allowing considerable for error because of a possible momentum gained by the needle, the reading was a remarkably low one.

The humidity at the 8 p. m. observation was 80 per cent; late in the afternoon, and early in the evening a number of persons made remarks about the "close" or "sultry" condition of the air.

The storm entered Minneapolis in the vicinity of Lake Calhoun, and from there it passed rapidly northeastward across the southern and south-central portions of the city to beyond the Mississippi River near Tenth avenue south. In nearly all the region mentioned very great damage was done to plate glass, chimneys, roofs, church steeples, telephone and telegraph poles and wires, and to thousands of very valuable shade trees. The Northwestern Telephone Company had over 7000 telephones rendered useless by the storm, and their poles and wires were in such condition that more than a week elapsed before all their telephones were in working order again.

While the barometer readings show undoubted evidence of the close proximity of a tornado funnel, the damage done shows, with a few exceptions, the effect of a straight blow of hurricane force. The trees, roofs, chimneys, steeples, and poles were thrown in nearly all cases toward the east or northeast, and it is probable that the damage occurred at the time of the shift of the wind just after the passage of the elevated tornado funnel. A few trees indicate by the different directions in which their branches were blown something of the effect of a whirl, but there was none of the rending, tearing, complete destruction, and utter confusion in the city such as accompanies the touching of the tornado funnel to the earth. It is possible that in at least two of the high buildings there was something of the explosive effect of the true tornado, as in the Guaranty Building and in Donaldson's Glass Block the large skylights seem to have been lifted sufficiently by an upward rush of air to raise the heavy glass from its fastenings, after which it fell back through the light wells to the floors below; very little, if any, of this glass was carried sideways by the force of the gale. Some of the plate glass, too, fell on the outsides of the buildings.

It is probably safe to say that the amount of damage by the storm in this city aggregated over \$500,000, not counting the damage to the trees, which can not be estimated in money.

The severity of the storm was not the same in all parts of the storm-stricken region, but it would be impossible to say that there were any well-defined paths of destruction.

A telegraph operator was killed by lightning while at work in a part of the city not in the affected portion, but there were no deaths due to the storm, though a number were injured, and many had narrow escapes.

Carefully compiled newspaper reports indicate that the storm was first felt in northeastern South Dakota, in the vicinity of Aberdeen, shortly after 6 p. m., and that it moved eastward parallel with the line of the Hastings and Dakota Division of the Chicago, Milwaukee, and St. Paul Railway, and a short distance north of it. No serious damage seems to

have been done in Minnesota until the storm reached Renville County, but from Renville County eastward through McLeod, Carver, Hennepin, Ramsey, and Washington counties, and thence into Wisconsin great damage occurred.

In McLeod County the path of destruction extended all the way across the county from west to east, with an area of 10 miles long by 1 mile wide, in which almost everything was entirely destroyed, including residences, farm buildings, stacked and shocked grain, trees, standing crops, and some cattle and horses, with a loss of 4 lives at or near Glencoe.

In Carver County, the greatest destruction was at Waconia, where the storm struck and destroyed the entire center of the village, killing 4 persons. At this point the fury of the storm resembled that of a tornado more than at any point east of McLeod County. The destruction extended east and west of Waconia about four miles in each direction. In Hennepin County, outside of Minneapolis, there was very great damage to residences, stores, and large manufacturing establishments in the towns of St. Louis Park and Hopkins, with 3 deaths in St. Louis Park; at Excelsior, on the south side of Lake Minnetonka, the loss was considerable, and there was a great deal of damage to the very fine properties on the north shore of Lake Minnetonka.

In Washington County, there was loss by the breaking up of large log rafts in St. Croix River, and to the extensive lumbering and other industries in and about Stillwater.

There were many exhibitions of the wonderful force of the wind, and many very strange and curious things were done by it.

Fifteen deaths were reported in Minnesota, 2 in South Dakota, and 1 in Wisconsin.

#### THE ORIGIN OF THE CUBA CYCLONES OF JUNE 13-14, 1904.

By MAXWELL HALL, dated Jamaica, August, 1904.<sup>1</sup>

On June 10 the barometric pressure over Jamaica was a little below the mean; on the 11th there was a further slight fall, so that the barometric pressure was about 0.1 inch below the mean that day. On the 12th and the morning of the 13th the pressure continued to give way, and at the Kempshot Observatory near Montego Bay the lowest was 0.3 inch below the mean at 7 a. m. on the 13th.

Up to the evening of the 12th this fall was due to a stationary cyclone or cyclonic depression, whose center was 20 miles west of the Negril Point Light-house. That evening the center began to move slowly toward the northeast, and then another center appeared early in the morning of the 13th about forty miles to the southwest of the light-house.

The first center we shall call *A*, and the second *B*.

*A* passed the light-house between 3 and 4 a. m., local time, June 13, and at 5 a. m. the wind veered to the south as *A* proceeded on its course, but, as *B* approached, the wind backed to southeast again; then it veered to south-southeast; the center *B* passed at about 8:30 a. m., and the wind continued to veer to south and southwest.

It may here be noted that the direction and force of the wind at any place under the influence of two centers are the resultants of the direction and force due to each center. Thus at 5 a. m. the wind at the light-house due to *A* would have been southwest; that due to *B*, southeast, with a resulting direction south.

A 6 a. m. the center *A* was near Kempshot, and it moved away in the direction of Santiago de Cuba at the rate of about fourteen miles an hour.

The cyclone *B* took a northerly course as far as Moron in

<sup>1</sup> A preliminary note on this subject appeared in the Monthly Weather Review for June, p. 273, under the heading "Cyclonic Depression and Flood in Jamaica." Later advices, showing that there were two separate depressions, necessitate a modification of the previous statement that the center took a curved path around the west end of the island.—Ed.